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NATIVE COPPER OF MICHIGAN.

BY

E. B. HINSDALE.

Few people have any knowledge of the native copper of Michigan, what it is, where it is obtained, or how it is procured and prepared for market ; nor is the magnitude of the industry understood. Last year there were produced 105,586,000 pounds of refined copper, which, at 17 cents per pound, about the price of copper at this writing, would amount to the sum of \$18,045,620. It is a rapidly-growing industry, and the new openings and additional machinery, now fast getting ready for operation, point to an increased production of at least 20 per cent. in pounds of copper for next year.

About \$250,000,000 in value have been taken from these famous mines, and yet no one suggests a probable limit to the supply or dares predict the extent of the possible future development of this great industry. Native copper is so called because each particular piece of copper as it is mined, whether it be many tons in weight or a fine particle of dust, is pure copper of the same kind and quality as the ingot copper of the world's markets. It is not alloyed with any other mineral, except it carries a trace of silver, and pure silver in small quantities is often found imbedded in it.

It was this purity of the metal that made these mines an object of interest to an ancient people, who discovered

and worked them extensively in some prehistoric age. Those who look at a map of Lake Superior will see a peninsula called Keweenaw Point, that juts out into the lake from the southerly shore in a northeasterly direction. It is a wee, small bit of land in this world to contain so much wealth and to possess so much romantic interest. These famous mines are situated along a line about in the middle of this peninsula, running from south-west to north-east, and copper has been found at various points along this line for about fifty miles. Ancient works have been found at numerous points for about thirty miles.

There is a deep mystery about these old works that it is impossible to fathom. In the opinion of many, they were worked by a race of men that preceded the Indian races found here when Columbus discovered this continent ; but others think that they were worked by the ancestors of the Indian races here when white men first penetrated this then far-distant country. This question can never be conclusively settled. This much is certain, that, whoever worked these mines in ancient days, all knowledge of the existence of the mines was gone from the Indians when white men rediscovered them.

These ancient miners were a diligent and persistent people. They seemed to know nothing of smelting copper, for there are no traces of molten copper. They were after pieces of suitable size to work by cold hammering into useful articles and ornaments. They understood the use of fire in softening the rocks to enable them to break away the rock from the masses of copper. They knew nothing of drilling or blasting, but used the

stone hammer freely. More than ten cart loads of stone hammers were found in the vicinity of the Minnesota mine. One of the larger class weighed thirty-nine and one-half pounds, while smaller specimens weighed five or six pounds each.

These stone hammers have a crease around them, obviously for a withe handle. Such handles are made of tough saplings or small trees, that will bend around the stone and, when firmly bound in their place by strips of strong bark, make a hammer about as effective as a modern blacksmith's sledge hammer. Ashes and wood coals have been found on the rocks at the bottom of the working, showing the use of fire to prepare the way for the effective use of the stone hammer. These mines must have been worked for centuries, judging by the extent of the works.

In one place the excavation was about 50 feet deep, and at the bottom were found timbers forming a scaffolding, and a large sheet of copper was discovered there. In another place in one of the old pits was found a mass of copper that weighed forty-six tons. At another point the excavation was twenty-six feet deep. In another opening at the depth of eighteen feet a mass of copper weighing over six tons was found, raised about five feet from its native bed by the ancients and secured there on oaken props. Every projecting point had been taken off by these people, so that the exposed surface was smooth.

Wherever the ancients found copper from a few pounds weight to a few hundred pounds in weight they were obviously able to utilize them, but the large masses were too heavy for them to handle. Their habit was to

throw the broken stone behind them as they progressed with their works. Many of their workings are ten feet or less in depth. The copper obtained by these people was wrought cold into axes, chisels, knives, spear heads, arrow heads, bracelets, buttons, beads, etc. It has been observed that very few of these articles are found near the mines.

There is a piece of low arable land a few miles from the mines, near the mouth of a small stream that runs into Keweenaw Bay, which the old miners probably used as their camping ground, for here has been the principal find of ancient tools on Keweenaw Point. These copper tools have been frequently found in the old earthworks in Wisconsin, Ohio and Canada, and the writer thinks that he has read of their being found further south in the Mississippi Valley. There are no human remains found near the workings nor evidences of human habitations.

The extreme severity of the winters and the absence of any evidence of permanent occupation has led many to suppose that the ancient miners migrated from some warmer climate in the spring and returned in the autumn, perhaps bearing their dead away with them. Whoever they were, whatever their habits were, many centuries have passed since they last worked these mines. Their trenches and openings have become filled up, or nearly so. Monstrous trees have grown over their works and fallen to decay, other generations of large trees have grown and perhaps fallen and decayed; how many, no one can tell. All that is known is that when the mines were rediscovered decayed trunks of large trees were lying over the works, with a heavy growth of

live timber then standing on the ground. Over one of these works in the Minnesota Mine, Mr. Knapp reports that a hemlock tree which he felled showed 395 annular rings.

The desire to fix a time when these old works were closed is intense, but cannot be gratified. It would be curious to compare the civilization of Europe with that of these people at the same time, if we could fix the date. What was Europe doing when these stalwart men of the northwest were swinging those tons of stone hammers in a no mean effort to accomplish a feat of mining, that would have been creditable a few years ago to our boasted civilization?

Had Columbus pointed the prow of his ship to these shores at the very time these men were industriously working these mines, or had the forest trees then grown over them? Dates would be interesting, but they cannot be established. Of one thing we are certain, a great modern industry has been, or, more properly speaking, is now being, built upon this ancient industry.

The Jesuits who visited this country about two hundred years ago learned from the Indians that there was copper in the country. Claude Allouez, who visited Lake Superior in 1666, states that pieces of copper weighing from ten to twenty pounds were frequently found by the savages. Pieces of copper that have been carried by the convulsions of nature from their original bed are found many miles from the copper veins. In 1864 a mass weighing about eighteen tons was found loose on the drift covering the rock near Portage Lake.

A copper rock now on the Government grounds in Washington has a strange history. It was brought from

the banks of the Ontonagon River. It is supposed to have been removed by the ancients in some way to the banks of the river, and, in an attempt to raft it over, it got away from them and sank to the bottom. When the water was low it projected above the surface and was an object of religious veneration. It is said to have been known for over 200 years. The Jesuits heard of it from the Indian priests, who, however, refused to conduct the missionaries to the spot where it lay, on account of a superstitious belief that when the white men had seen it the Indians would be destroyed: a belief not without reason.

In 1820 General Cass sent a party of men to fetch the rock away, but, owing to its great weight, they did not succeed. Another attempt was made to remove it in 1827, but as the river was high and it was pretty much covered with water, this attempt failed. In 1842 another attempt was more successful. It was removed to the mouth of the river. A Mr. Eldred claimed to own it. It was afterwards claimed by a Government agent, and finally removed to Washington. By act of Congress Mr. Eldred was paid \$5,655 for it.

The first attempt at mining within historical times was in 1771, but the location was not skilfully chosen and it was a failure. It was not until the report of Dr. Douglass Houghton, State Geologist, in 1841, that there was any public knowledge of native copper in place on Keweenaw Point. This report awakened great interest in this country, and explorations and developments have gone on with generally increasing interest to this date. A history of the early struggles and trials of those who took part in the development of this country would be

exceedingly interesting. It is a pity the task is not undertaken by some competent person before death has removed the last of the actors who could tell the tale.

It was not until 1844, after the Indian titles were extinguished, that mining began in earnest by white men. Hundreds of companies were unwisely organized. Speculation was rife. Works were begun under great difficulties, and knowledge of mining was limited. Capital was also limited. The usual result followed—a grand collapse—in 1847. Disappointment and failure were general, with some notable exceptions. The methods of mining then employed were primitive. The country is full of abandoned works, and many of them are now being reopened with fresh capital.

In the early days the mining was, in some of its methods, not unlike those of the ancient miners; but some modern ideas were introduced. Drilling, blasting, and stamping in a crude way were employed. In all cases, except where large masses of copper were found, the ore was roasted in burrows. These were formed by layers of wood and layers of ore. In the roasting process care was taken not to have the fire hot enough to melt the copper. The large pieces of copper were sent to the smelting works, the smaller pieces of roasted ore were stamped and washed, and the resulting copper was put in barrels and sent to the smelter. This was called "barrel work."

The masses of copper found in the earlier days have not been equalled in size in later years. In fact, large masses of copper are not as profitable to find, owing to the difficulty and expense of getting them out and cutting them up. Among the numerous masses of copper,

the most notable was found in the Minnesota Mine, in 1857. It was difficult to dislodge it from its native bed. Charges of powder, first of 125 pounds, gradually increased to 550 pounds, failed to dislodge it. Finally a charge of 750 pounds, securely tamped under it, was fired, with the result of lifting from its bed without fracture a mass of copper 46 feet long, 18 feet in breadth, and 9 feet thick, the latter two measurements being taken at the greatest distance, the whole mass weighing about five hundred tons. In cutting it up fifteen tons of chips of copper were made.

In the early days of mining there was great difficulty experienced from the isolation of the country and want of transportation facilities. There were no railroads or telegraphs, and the only means of transportation was by water. All supplies for men and animals had to be brought up before navigation closed. The winters were long and severe. When once the cold weather began the people were as isolated from the rest of the world as the Laplanders. For from six to eight months they had little or no communication from "below." An occasional mail would be brought in by hardy adventurers on snow shoes, with dog trains.

One of the pioneers related to me that the news of the first President Harrison's election in November, 1840, and of his death the following April, came in the same mail about two months after his death. With all their trials and deprivations those who wintered here had many social enjoyments and much real pleasure. There was much good society among those in charge of the works, and innumerable stories are told of the good times they had in the old days of forty years ago.

In those days men walked ten miles on snow shoes to make New Year's calls. A short neighborly call would usually last at least a week.

All this is changed now. Railroads, telegraphs, telephones, and electric lights and a greatly developed industry have inaugurated a new era. The theatre of principal mining interest has changed. The greatest mine for many years has been the Calumet and Hecla. The development of this mine began about 1867. Its progress has been wonderful, and to-day it ranks as one of the greatest copper mines in the world. Its works are situated on what is locally known as the Calumet and Hecla Conglomerate.

This is a vein at its mine of from six to twenty-eight feet in thickness, generally carrying copper interspersed through the rock, the larger pieces, with rare exceptions, usually weighing only a few ounces and from that of all sizes down to dust as fine as gold dust. No very large masses of copper have been found, none worthy of notice compared with those before referred to. It is the universality of the small pieces of copper through such a vast quantity of rock that makes the marvellous wealth of this mine, although in their explorations the workmen have found long stretches of rock too lean to be worth milling.

In some of their shafts paying rock has been found near the surface. They were fortunate in opening such shafts in very rich rock near the surface in their early days, which gave the company its financial strength, enabling it to pay good dividends and push explorations. The shafts extend for about two miles along the vein, and are fourteen in number. Many of the shafts have

been sunk to a great depth before finding paying rock. One of the latest explorations descended 2,300 feet before paying rock was found. All of the shafts have found paying rock when pushed deep enough, and all are richer at their greatest depth than at the surface.

A study of these results as well as the results at other mines, has led to the conclusion that the most profitable mining is to be found at great depths. The method of mining by this company up to this writing has been to sink their shafts down on the slope of the vein. Captain Daniell, one of the ablest miners of that country, who has been for twelve years in charge of the Osceola Mine, reasoning out the probable course and character of this wonderful vein, backed by abundant capital, inaugurated a bold and original idea of mining. Selecting a location beyond the lands of the Calumet and Hecla and above the vein he calculated that a perpendicular shaft should strike the vein at a depth of 2,300 feet. It was a bold enterprise to go out into the open country and lay out the work upon land that showed no indications of copper at the surface, and enter upon a labor of years to find a vein of copper, the continuity of which was unknown except by logical reasoning, from the surface openings of the Calumet and Hecla mine.

What freaks of nature in the bowels of the earth might defeat his logic no man could tell. Patiently year after year the work went on, and at the end of three years and four months the expected vein was found within thirty feet of the expected depth. The result was the opening of the famous Tamarack Mine, which, with other mines now opening by the same men, bid fair to rival the Calumet and Hecla. The Tama-

rack Mine has been in successful operation for four years.

Encouraged by this success, a second shaft has been sunk on the same location, which has just come into successful operation (August, 1890). The vein, where pierced by these two shafts, is of the same general character as that in the Calumet and Hecla. On another location the same company has sunk two shafts to a depth of 2,300 feet, but do not expect to reach the copper until November next at a depth of about 2,500 feet. A third mine of two shafts has been commenced on still another location, that has attained a depth of only 500 feet, but is expected to be sunk about 3,800 feet before reaching copper. These are bold departures from the traditional method of mining in this country, which heretofore had been to sink on the slope of the vein.

Within about two years ago the Calumet and Hecla commenced an enormous vertical shaft, intending to cut the vein on their land at a point below their present workings at a depth of about 3,700 feet. It will take nearly two years before this shaft can reach the vein. It will be interesting to note the result of all these unfinished works. If the calculations of their projectors are not at fault, they will put into the shade all past achievements in copper mining in this country.

Modern methods of mining and milling have made great advances over old methods. The rock is no longer roasted. That method was abandoned years ago. Black powder has been superseded by high explosives that throw down much larger masses of rock. The hand drill has given place to drills driven by compressed

air. All the rock is stamped in mills of great power. In 1860 a report was made of a mill that stamped thirty-three tons per head per day. Now a single head will stamp 260 tons per day.

The method of procedure is to raise the rock to the surface in such lumps as it is left in by the blast in the mine. Here the large pieces are put through stone crushers that break it into lumps not larger than a man's fist. It is then dumped into cars and taken about four miles to the border of a small lake, where it is stamped and washed, a process called milling. After the earthy matter is worked out as far as practicable, it is sent to the smelter, where it is cast into the various forms of copper required in the markets of the world.

It is difficult in a few words to give an idea of the magnitude of these operations. The details would be tiresome. A few facts will serve in some measure as indices to lead the mind to comprehend the subject. The people who live almost together upon the group of mines, of which the Calumet and Hecla is the principal one, number about 12,000, all of whom are either directly or indirectly supported by the mines. About half as many more are supported around the mills and smelting works.

All the mines have to pump water up to their mills to wash the earthy matter from the copper. The amount of water pumped daily by the Calumet and Hecla to its mill is about thirty-four millions of gallons, a good supply for a city. But more than this, this company has nearly completed a pump that will throw about fifty millions of gallons a day, or an amount in excess of half the water supply of the great city of New York prior

to July, 1890. The dividends this company has made to its stockholders exceed \$35,000,000. It is only by such comparisons that the mind of the general reader is brought to a comprehension of these great works.

The amount of sand washed into the Portage Lake became so great that it threatened to stop navigation, and the United States Government has had to interfere and prevent further use of the lake. Many acres of made land are now in the lake from these washings. At present most of the mills are on Torch Lake, but the time will come when Lake Superior will have to be the dumping ground.

The Calumet and Hecla sends daily to the smelting works about 135 tons of mineral, as the copper is called after stamping and washing, which, when smelted, will produce about ninety-five tons of pure copper daily. The greatest depth of the Calumet and Hecla is over 3,000 feet, and the greatest depth of the Tamarack is about 2,850 feet. These two mines, the greatest producers, are selected by way of illustration. Proper limits forbid further details in this paper, although the operations of the Quincy, the Atlantic, the Osceola, and others would be interesting.

The native copper of these mines is the only considerable body of such copper yet found in the world. The character of the mine improves, the greater the depths to which they are worked. In this respect this district is different from many others. The Cornwall mines of England, as they went down, gradually changed to tin mines. In Montana the mines are of decreasing value when worked below the water level of the country. The Chilian mines, that once dictated

the price of copper for the world, can no longer be worked with much profit, and are not a serious factor in the market. The native copper of Michigan has more tensile strength and greater conductivity for electrical purposes than any other. It commands the highest price in the market for its better adaptability for many kinds of manufacturing purposes.

In the deep mining of this country no particular change is noticed in the temperature of the mines as they go down. Water is not encountered in troublesome quantities. The veins seem to be almost hermetically sealed. These are all favorable conditions for mining. A striking feature of these improvements is the ponderous machinery, engines, pumps, stamps, and fly wheel, as fine as any in the world, housed in large brick and stone buildings with iron roofs. All this in a place where the "forest primeval" stood in its solemn stillness thirty years ago. The trees were of phenomenal size and the sunshine hardly penetrated their close and tangled growth. Even now the stumps have to be grubbed out to make way for advancing improvements.

Such are the Lake Superior copper mines as they appeared to me in my leisure hours of outing in 1890. Great as have been their strides in the past, it seems to me that the men in charge are just beginning to understand the business and country. Wonderful as the improvements have been, others are to follow. Advanced thinkers are looking forward to the time when electricity will come to their aid to drive their drills and perhaps light these subterranean caverns. The time will also come when a limit will be reached for hoisting by steam power from the surface.

When I suggested this difficulty to Captian Daniell his quick response was : " Electricity can be used to bring the ore within reach of a surface hoist." At the suggestion of expense he said : " That is not a very material factor." His answer suggested large thoughts of future possibilities. It is refreshing to get away from the rut of metropolitan life and be with men who are doing the really big things in this world, stalwart thinkers who form great plans and patiently carry them out. Whenever a just estimate of the really great men of the land is made up, a successful mining captain or superintendent will hold no mean rank.

August, 1890.